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TUNE AND TONE: GENERALIZED SYNTAGMATIC PITCH PATTERNS CONSTRAINED BY PARTICULAR LEXICAL PATTERNS

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Certain phenomena of tone languages, such as 'flip-flop' tones (a change from high-low tones to low-high at the start of a particular word), and anti-assimilation (a high tone becoming even higher before a low) can be formalized into rules, but do not seem to be natural phonological processes. This paper proposes three hypotheses of over-riding principles governing such tone phenomena which indicate the phonetic structural sources of such rules, and discusses them in relation to five African languages: Kalenjin (Kenya), Moba (Gur, Togo), Lobi (Gur), Gouin (Gwɛ̃) and Ebrié (Kwa, Lagoon).

The hypotheses are:

1. That tonal tunes may represent generalized pitch melodies based on syntax, which override lexical tones.
2. That permutation of matrices of tonal data may illuminate the direction of tone changes in a language.
3. That in some languages an anti-drift (the movement of a high tone to a still higher pitch) may be introduced just before the point when conditioned downdrift occurs, thus introducing a kind of polarity between high and low.

Certains phénomènes des langues tonales peuvent être formalisés par des règles mais ne semblent pas être des procédés phonologiques naturels; par exemple les tons 'flip flap' (c'est à dire le passage d'un ton haut suivi d'un ton bas à un ton bas suivi d'un ton haut) et l'anti-assimilation (c'est à dire le passage d'un ton haut à un niveau encore plus élevé devant un ton bas). Cette étude propose trois hypothèses relatives aux principes premiers gouvernant les caractéristiques tonales de ce genre et indiquant les sources structurelles phonétiques de ces règles. Elle les examine par rapport à cinq langues

africaines: le kalenjin (Kenya), le moba (voltaïque, Togo), le lobi (voltaïque), le gouin (gwɛ̃) et l'ébrié (kwa, lagunaire).

Ces hypothèses sont:

1. les schémas tonaux peuvent représenter des courbes mélodiques généralisées qui sont basées sur la syntaxe et qui l'exportent sur les tons lexicaux;
2. la permutation des matrices des données tonales peut éclairer le sens des changements tonaux d'une langue;
3. dans certaines langues, une 'anti-chute' (c'est à dire le passage d'un ton haut à un niveau encore plus élevé) peut se produire juste avant le point où une chute mélodique automatique a lieu; ainsi une sorte de polarité est créée entre les tons hauts et les tons bas.

I. Puzzles and Wishes

In 1966 at the sixth session of this congress I spoke, with others, on "Phonological Hierarchy and Tone". Yet ever since then several problems have troubled me.[1] In that paper, for example, I gave data from Ian Gardner on Abua (Nigeria) which showed a change from high-low tones to low-high at the start of a particular word such as 'forgetting'.

ọ̀dị́ rạ̀búlạ́	'Father (is) forgetting'
ọ́dị̋ rạ̋bùlạ́	'Father (is) not forgetting'

The data: Negative had a special, extra-high tone; it carried over from the first word to the second, changing the original high to low; this led to a flip-flop from low-high to high-low. But *why* should the change occur? Extensive formal rules can be elegant and intellectual fun, but if they do not give insight into the background *natural mechanism* driving such rules, I am not satisfied. Clements (ms.) says in reviewing Fromkin's (1978) tone survey that "tone remains for the great majority of phonologists an unassimilated puzzle whose eventual consequences for phonological theory as a whole remain almost totally unknown"; he, too, finds difficulties. For another example from Abua, referred to in Pike (1971:83), note the stem <u>bómè</u> 'to put on', where the addition of -<u>á</u> 'habitually' changes the prefix tone and the first tone of the stem itself:

à-bómè 'he put on'

á-bòm-á 'he puts on habitually'

In addition to the flipflop tones, an unknown factor in some languages leads to a high tone becoming even higher before a low. This is especially confusing, since high *after* low is held lower than normal. In a sequence of HHLH, why should the second H be raised, but the third be lowered? Both are illustrated, for example, in Izi (Meier, Meier and Bendor-Samuel, 1975).

A further problem: In many of the West African languages, the occurrence of specific sequences of tone combinations is by no means random. Given two tone levels, there is not a random sequence of permitted orders in words of several syllables, or of phrases, or even of clauses. Why not? In this kind of situation I am by no means content with the *mere* representation by rules which say *which* do or do not occur, I feel the need for a more *natural* hypothesis in the form of *overriding principles* which in fact indicate the phonetic structural sources of such rules.

A sample kind of answer for a problem which has engaged the attention of many scholars is downdrift and downstep. There, the general phonetic lowering of pitch over a considerable span was seen as an intonational feature superimposed on the phonemic structure, with a high tone having a lowered allotone after a low toneme. Within this *natural setting* of progressive, partial assimilation, the loss of low (or its assimilation toward high) left the prior lowering effect unchanged, with a resultant phonemic downstep to be handled in some way.[2]

II. Dreaming the Solution

Here I suggest several hypotheses designed to meet these needs. Each is somewhat general, in order to be useful in a variety of quite different circumstances.

A. Tonal Tunes as Representing Generalized Syntactic Pitch Melodies

For the first hypothesis I draw on work which was done in Mexico on the Huave language (Pike and Warkentin, 1961). In that language there are two clearly contrastive phonemic tones, which the language helper learned to write accurately in two weeks without special instruction (but just by watching over our shoulders as we struggled to analyze tones). No minimal lexical word pairs differing only by tone were found by Warkentin after fifteen years of speaking the language. But the lexical sets differing by tone were clearly contrastive both in isolation and in context. The pattern of the tones on any one word, however, differed markedly

according to the syntactic position in which it occurred. As one kind of such difference, for example, the noun in subject position has the pattern of tone sequences which it would have in isolation; but in object position, after the verb, the pattern is different. At the same time, the verb pattern also changes, and a verb *plus* its object forms *one generalized pattern*, even though this pattern differs from others according to the underlying verb tone and the basic underlying noun tone.

Into that verb-object pattern, the adjective before the noun also merges. The verb, even if ending on a sequence of high to low in isolation, will end high before the object. The adjective will be high on all its syllables. The noun will end low, if it ended low in isolation, but often with changes at earlier syllables. Thus there is usually a *dome shaped contour* (rising and later falling) over the whole phrase. (The exception: If a noun has the pattern low-high, with the high stressed, it will raise the low to high, to enter the dome shape, but will resist the lowering of the final syllable.)

Nouns which contrast tonally in isolation often continue to contrast after such partial *molding to the syntactic tune*. A wide variety of grammatical word classes and subclasses, affect the actualization of these melodies. I do not have space to summarize the details here; the reader may consult the article mentioned for that. Instead, I present just one artificial example, to show the idea most clearly. (The number of moras per syllable can vary from one to four, with same or different vowel qualities in the vowel sequences.)

tíìd	àkóòòč	
flea	*cuts*	'(The) flea cuts (something)'
àkóóč (''')	tììd	
cuts	*flea*	'(Something) cuts (the) (Adj) tick'

Could such a dome pattern be responsible for the over-all contours of some African utterances? (And would some scholars call such a nonspecific but general situation a "conspiracy", perhaps?) And could the opposite, a *trough* pattern occur contrastively?

B. Permuted Matrices as Suggesting the Direction of Tonal Tunes

A second hypothesis arose from pondering once more the work on matrix permutation of the Bimoba verb (Pike and Jacobs, 1968). There, a matrix of verb forms lined up with one grammatical feature given priority, looked very different from the same data lined up with a different starting priority for its rows or columns. The various chartings revealed groupings which clearly

implied different rules which had been hidden from us. Could it be that the lining up of the tone data in other languages might help find some generalized pattern which would illuminate the many different changes of tones in words in different contexts? Or would it suggest general principles of probability in the development of tone fusion in one direction more than in another?

C. Widening the Pitch Gap by Increased Polarity or *Antidrift*

Neither of the two hypotheses suggested above, however, helped to explain the upstep of a high before a low, when right after that low tone a high might be held down lower. Why the *progressive assimilation* but the *regressive anti-assimilation?* Let us suppose that the very factor of the downdrift threatened communication by a loss of contrast -- what might be done? We already know that there may be "starting over" with a renewed high key after one phonological sentence is finished. Without that, the speakers could be choked into silence, physiologically, if drift continued down to pitches lower than they could pronounce, or lower than allowed retention of high-low contrast. Something, *somewhere*, has to start over at a higher level. Why snould it *only* be at the *end* of phonological sentences? My hypothesis here: In some languages an *antidrift, the movement of a high tone to a still higher pitch,* may be introduced just before the point where the conditioned downdrift is effective -- i.e. on a high syllable just before a low one. This antidrift tendency introduces a kind of *polarity* between the high and the low, thrusting them apart when they might otherwise be merging because of the assimilation. This step-up can itself become a process phoneme if in any particular instance the conditions under which it first appears are lost; or it may result in a new tonemic level, but with irregular distribution.

III. Intonation as Register Shift in Clause Domain in Kalenjin (Kenya)

Thomas has shown (1974:26) that once levels of the phonological hierarchy are given closer attention, it is still not easy to distinguish between tone and intonation; the latter is pitch related to a level higher than that of contrasts, for example, on the syllable level. This emphasizes the need for careful statement of the *domain* of a phonological pattern. Iver Larsen (personal communication) has worked out the vowel harmony system of the Koony dialect of Kalenjin (Southern Nilotic) of Kenya. In Karan and Pike (in press, in the Sudan), the domain of that harmony is seen to be the grammatical word as spoken in isolation as comprising a phonological word, but not the fuller phonological word from a slowly-spoken text. That is, in the short text which we studied and which was marked for the vowel harmony, even a very artificially-slow speech did not cut the rhythm unit (phono-

-logical word) small enough to make it isomorphic with the domain controlling vowel harmony. Rather various kinds of particles were encliticized to the grammatical words.

But another domain[3], much larger, is also important to pitch in this language. At the end of a phonological clause (a pause group) the pitch *register* i.e. the whole *frame* of relationships of the tonemes) may move up or down sharply. It is the *abruptness* of this shift, rather than a gradual drift up or down, that is startling. The change occurs on the last or the next to the last syllable before the pause. The number of pitch contrasts at such a point remained constant at three. We found, in this preliminary study of one text, with experimental substitutions at various places in the text, that a 'falling' intonation raised the register one step (old mid would now be homophonous with old high). That is, we used *paradigmatic replacement in the domain of the pause group, with the initial text as a frame.* A 'question' pattern, on the other hand, has the mid and high moved up two steps at the end. A 'to be continued' intonation shifts the register down one step. A 'lack of interest' intonation may have a two-step down downwards action. (We hope that an extensive study will be made some time to amplify our preliminary probings.)

But the lesson to be learned: The domain which controls register shift may be much more extensive than just an adjacent pair of sounds, and may be much more abrupt than a gradual drifting up or down.

IV. Matrix Permutation Pointing toward a Pattern Tendency of Fusion in Moba

Jann Russell is preparing a paper on downdrift and phrase level tonal phenomena in Moba (Gur, Togo). Four phonemic levels of tone seem verified. She may eventually postulate a fifth level. Other problems are being given further study by Russell; e.g. conditioned phonetic levels; application of some of the data to connected text; some uncertainties with effects of placement of tone sequences in relation to mora and syllable. Her charts are being revised, for that article, to increase the reliability of some of the bits. Nevertheless she has made available to me, for this conference, some of her advance data. I am grateful, since it illustrates an important principle of methodology: *matrix permutation can help to give insight into general tune tendencies*, or assimilation probabilities, and hence to point out profitable areas of research early in the work.

Specifically, she had used a frame in which a large number of nouns could be substituted after a number of different verbs. This was in the frame sentence:

u wõ (verb) (noun) won
he yesterday (verb) (noun) yesterday

'He did something to something yesterday'

These materials were put into a chart (see Figure 1). The column to the far left gives the verbs with the tones, that they have when in isolation. The row at the top lists the noun tones, also as in isolation. The intersection of row and column shows the noun tones, in the sentence frame above, after the respective verb classes.

Figure 1 has numbers in the cells, with no easily discernible pattern. Close inspection, however, shows columns 4,5 and 6 with cells having tones 23,33, and 34 to be stable in *that* frame, although differing from the isolation form. In Figure 2, she has moved these so they can be seen together at the far right. In addition, Rows 2 and 5 were lowered, in order to get the noun 22 entries together. Pattern in Figure 2 began to emerge clearly: the *low* tones began to cluster to the right, with higher tones to the left; the highest tones began to form a group in the upper left. But there are a few irregularities. in Column 8, the 12-entries are separated; and the stable Column 2 is separated from the other stable columns. In Figure 3, all of the stable columns are at the right.

		1	2	3	4	5	6	7	8	9
Tones of nouns in isolation ⟶		11	21	22	23	33	34	41	42	44
Tones of verbs in isolation ↓	1 11	11	21	11 22	13 23	33	34	22	12	11
	2 14	22	21	22	23	33	34	22	12	14
	3 22	11	21	22	23	33	34	41	42	44
	4 21	11	21	11 22	23	33	34	12	12 23	11
	5 24	22	21	22	23	33	34	31	42	44
	6 31	11	21	22	23	33	34	12 22	12	11
	7 34	11	21	22	23	33	34	41	42	44

Figure 1. (page 28) In Moba, nouns have different tones after different verbs, and before various words. Here, the cells are filled with the tones of nouns which occur after verbs of various tone classes, and before the particle won: 'yesterday'. In general these tone patterns are representing words of two moras, but this factor needs further study. In addition, various corrections of detail may need to be made. The method, however, is useful at this point in an investigation. These preliminary data were made available to me by Jann Russell. They are in the process of revision and expansion. The tone of won is 32.

	Noun / Verb	1 11	3 22	9 44	2 21	8 42	7 41	4 23	5 33	6 34
1	11	11	11 22	11	21	12	22	13 23	33	34
4	21	11	11 22	11	21	12 23	12	23	33	34
6	31	11	22	11	21	12	12 22	23	33	34
3	22	11	22	44	21	42	41	23	33	34
7	34	11	22	44	21	42	41	23	33	34
5	24	22	22	44	21	42	31	23	33	34
2	14	22	22	14	21	12	22	23	33	34

Figure 2. The display of Moba noun tones, from Figure 1, with rows and columns in a permutation designed to bring out some pattern features of the system. Notice, especially, the uniformity of columns to the right, and clusterings of high tones to the upper left.

	Noun / Verb	9	1	3	7	8	2	4	5	6
		44	11	22	41	42	21	23	33	34
2	14	14	22	22	22	12	21	23	33	34
1	11	11	11	11 22	22	12	21	23 13	33	34
4	21	11	11	11 22	12	12 23	21	23	33	34
6	31	11	11	22	12	12	21	23	33	34
3	22	44	11	22	41	42	21	23	33	34
7	34	44	11	22	41	42	21	23	33	34
5	24	44	22	22	31	42	21	23	33	34

Figure 3. The same Moba data as in Figures 1 and 2, with further permutations. The noun set 21 joins other columns to the right, all of which are stable before the frame-final word won: 'yesterday'; changes in the noun classes caused when they occur before other words with different tones are not shown. Nevertheless, a start is made at being able to see something of a general tendency for tone patterns to be more unstable after high tones than after low ones.

And now a study of Figure 3 calls to attention the group of 11-nouns in the cells. Some of these are related to the nouns with isolated 11 forms, except after a 14 or 24 verb; this suggests that a further figure might move the first row toward the bottom of the chart. And the nouns of pattern 44 assimilate to 11 after a verb ending in 1. In a related way, the noun patterns 41 and 42 are affected after verbs in rows 1, 4, 6, 2 -- and the nouns in column 7 are further affected after verbs in rows 3, 7, 5.

After such data are more finally revised for detail, one can either choose to describe them in the form of specific rules alone, or one can attempt to add, also, generalizations related to the more stable forms, the unstable types, and the fact that something -- some general tune type perhaps -- leads, usually, to the raising of tone 4 before another tone, following verbs ending in tone 1, and before the time word won.

Yet this is still insufficient to give us rest. We still need to watch for more specific tone melodies which may cause the override of the general pattern on the specific tone sequences. This must wait, in Moba, for still further research.

V. Polar Contrasts of Morphophonemics from Intonation Override

Jacques Becuwe of Abidjan has made available to me some interesting data on Lobi (Gur). Somehow the speaker anticipates the length of a sentence. If he knows that a long sentence is in the making in his head, he *anticipates the need for "room" for downdrift or downstep by starting that sentence extra high.* This justifies, in my view, assumptions in this paper which imply some kind of *psycholinguistic reality to the gap size between high and low tones.* In addition these readers still *preserved the assimilation* effects of words which they *knew were to follow,* even when they read slowly, word by word, with pauses between the words.

But he met a special morphophonemic problem. He needed a reconstructed (or "latent") low with no segmental morpheme carrying it in order to explain certain downdrift or downstep characteristics. But, sometimes, the postulation of that same latent low in the same place in the phrase led to wrong predictions. In those instances that same reconstructed zero morpheme acted like an underlying high tone, instead of a low. He called this queer hybrid with its double characteristics a "polar" tone. In the first phrase below, khɛ̀r 'wife' is held to a lowered pitch, by the latent low before it. In the second, the low toned cɔ̀ is raised to high, by a rule that says (elsewhere) that every low becomes high immediately after a high; but this would not have taken place, had there not been a high before it -- hence the polar high latent tone reconstructed in the second illustration.

ʔí	*ɔ̀	khɛ̀r	——————>	ʔí	khɛ̄r
my	...	*wife*			
fì	*ɔ́	cɔ̀	——————>	fì	cɔ́
your	...	*house*			

But the question arises: Is there a possibility of explaining this in a somewhat different way, to relate it to the other hypotheses of this present paper? Perhaps so. The price would, to me, seem to be that of postulating a *polarity* tendency, which is a counterflow to the downdrifting assimilation. It would be a tendency to preserve contrast, as lows begin to cover too large a span for comfort. That is, in the second illustration just above, the "expected" sequence of two low tones was in fact avoided in the data. The rule technique suggested by Becuwe was to have the reconstructed low latent tone arbitrarily reconstructed as high

in that context. The alternative which might be considered, is to suggest that the sequence of L*LL was *overridden by the polarity-intonation principle*, so that the last of the three (at some unspecified time in the past, and with unknown restricting conditions) moved up to high.

Notice, further, that one can restate this in a somewhat different form. This language has a tendency to partial assimilation by a low of a high immediately following it; but there is *anti-assimilation*, a *polarity dissimilation* if in some unspecified conditions too many lows are found together. (As I take the term polar from Becuwe here, I use the term dissimilation[4] in a fashion which, Jean Reimer pointed out to me, is related to the way it is used in some rules by Constance Kutsch Lojenga, see below, Section VII.) This brings together downdrift, upstepping high before low, downstepping high after low, the polarity under dissimilation and the anticipatory extra rise at the start of a coming sentence which the speaker senses is going to be long.

VI. Domain of Assimilation and of Tone Occurrence

For Gouin (Gwɛ̃), Ed Lauber has given me preliminary data (subject to phonemic revision) illustrating the fact that there the phonological word controls the extension of a pattern of high plus high, or of a pattern of low plus high, or high plus low over the entire word -- even if that word be composed of two, three, or four syllables (but never just one syllable), or of a word plus adjective.[5] In the following samples, a noun root is followed by a noun class suffix, so that the pattern as a whole includes that suffix, not just the root.

Tone pattern	Singular	Plural	Meaning of root
HHH	péɪ́íéŋgú	péɪnɪ́	'tail'
LLH	kʊ̀ʊ̃naaŋó	kʊ̀ʊ̃ɪmbá	'chicken'
	kʊ̀ʊ̃nàafàfaɪŋó		'pretty chicken'
LHH	sʊ̌nŋó	sʊ̃nã́ãmbá	'horse'
	sʊ̌ŋfáfaɪŋó		'pretty horse'

VII. Tone Tunes which Force Massive Morphophonetic Changes, Loss of many Mid Tones, and Loss of Many Glides, but with the Development of Polarity

But the most complex and intriguing data, with relation to the hypothesis (of tonal tunes) which arose from the question about the Huave (Section II A) comes from data made accessible to

me by Constance Kutsch Lojenga, for Ebrié (Kwa, Lagoon), She has in preparation a forthcoming article on its tonal system. At the moment, the data are most extensively worked out for the noun phrase (which I refer to here), but other materials are in preparation -- which may later cause minor revision in the preliminary morphophonemic and tune analysis discussed here. Nevertheless, the phonetic data are very solid: I spent four weeks double-checking them out very carefully with her and her language helper, and checking them against a limited set of her instrumental recordings of pitch and intensity. I am therefore convinced of the solidity of the contrastive data which she has currently available, in reference, for example, to the classes of lexical sets of nouns in their divergent morphophonemic reactions. We worked together for some time developing the tentative view of the reconstructed forms and rules suggested here.

See Figure 4, at this point, in order to follow the discussion.

Figure 4. In A, six noun classes occur in the rows, with their tones replaced morphophonemically in accordance with the frames in which they occur. Capital letters represent the tentative underlying forms; lower case letters represent phonemic (surface) forms.

These sets represent about 300 nouns. In B, the sets 3 and 6 are repeated, because they have different morphophonemic replacements in the frames from the replacement which they have in A; the high pronoun affects them differently from the low pronoun of A. (The other sets (1, 2, 4, and 5) do not differ after high versus low pronouns; so are not repeated here.) The tonal data have been made available to me by Constance Kutsch Lojenga from a forthcoming article. Kutsch Lojenga and Pike worked together on the preliminary version of the reconstructed forms and rules presented here.

A. On Reconstructing Three Levels and Three Glides

Notice that tone glides occur *only* before pause (or before some high-level phonological unit; that is, on this chart they occur only on the forms in isolation (Column 1), or at the end of the various frames (Columns 2-7). This important fact was given heavy weight in the thinking of Kutsch Lojenga, when we searched for a starting point for setting up reconstructed forms. Since capital letters are used for our reconstructed forms, and lower case forms as phonemically manifested (the surface forms), a glance down Column 1 shows that Sets 3 and 4 are reconstructed with the glides as occurring there.

On the other hand, I was impressed, early, with the contrastive sets showing noun roots in phonemic contrast, in nonfinal and non-initial positions, in Frames 2 (between surface low and high), 3 (between surface low and high-low), 4 (between surface low and

Citation forms in isolation, with classifier in parenthesis. A.	1. Tone of noun in isolation (classifier) root	Nouns in frames which have a low-toned pronoun (the classifier drops off when the pronoun occurs) 2. 'my ... good' ɓɛ̌ ... ɓwá L ... H l ... h	3. 'my ... it is' ɓɛ̌ ... lɔ̂ L ... H^L l ... h^l	4. 'my ... two' ɓɛ̌ ... ɓɔ̀ L ... M l ... l	5. 'my ... one' ɓɛ̌ ... ɓɛ̀ L ... L l ... m^l	6. 'my ... small' ɓɛ̌ ... ɓlî L ... H^M l ... h^m/l	7. 'my ... nine' ɓɛ̌ ɓlɔ̂ L ... M^L l ... h^l/m^l
1. 'thing' (á)yí	(H) H (h) h	L H H l h h	L H H^L l h h^l	L H M l h l	L H L l h m^l	L H H^M l h h^m	L H M^L l h h^l
2. 'palm nut' (á)jì	(H) M (h) l	L M H l l h	L M H^L l l h^l	L M M l m l	L M L l m m^l	L M H^M l l h^m	L M M^L l l h^l
3. 'pot' (á)ɓwɛ́	(H) H^M (h) h^m	L H^M H l l h	L H^M H^L l l h^l	L H^M M l m l	L H^M L l m m^l	L H^M H^M l l h^m	L H^M M^L l l h^l
4. 'body' (á)phɔ̂	(H) H^L (h) h^l	L H^L H l m h	L H^L H^L l m h^l	L H^L M l h l	L H^L L l h m^l	L H^L H^M l h l	L H^L M^L l h m^l
5. 'paddle' (á)bɛ̀	(H) L (h) m^l	L L H l l h	L L H^L l l h^l	L L M l l l	L L L l l m^l	L L H^M l l l	L L M^L l l m^l
6. 'kind of food' (á)yî	(H) M^L (h) h^l	L M^L H l l h	L M^L H^L l l h^l	L M^L M l l l	L M^L L l l m^l	L M^L H^M l l l	L M^L M^L l l m^l

The frames in B are as in A, except that the pronoun in B has high tone.

B.		'his ... good' ɓɛ́ ... ɓwá H ... H h ... h	'his ... it is' ɓɛ́ ... lɔ̂ H ... H^L h ... h^l	'his ... two' ɓɛ́ ... ɓɔ̀ H ... M h ... l	'his ... one' ɓɛ́ ... ɓɛ̀ H ... L h ... m^l	'his ... small' ɓɛ́ ... ɓlî H ... H^M h ... h^m/l	'his ... nine' ɓɛ́ ... ɓlɔ̂ H ... M^L h ... h^l/m^l
7. 'pot' (=3) (á)ɓwɛ́	(H) H^M (h) h^m	H H^M H h m h	H H^M H^L h m h^l	H H^M M h m l	H H^M L h m m^l	H H^M H^M h m h^m	H H^M M^L h m h^l
8. 'kind of food' (=6) (á)yî	(H) M^L (h) h^l	H M^L H h m h	H M^L H^L h m h^l	H M^L M h l l	H M^L L h h m^l	H M^L H^M h h l	H M^L M^L h h m^l

low) and 5 (between surface low and mid-low). The level high reconstructed as such in Row 1; but no simple correspondence across the rows allowed an easy, transparent reconstruction of mid or of low. On the other hand, the presence of the three phonemic levels suggested that the surface glides high-low, and high-mid, could be phonemically related to the levels high, mid, and low; and that the remaining glide, which dropped lower than low (both perceptually and on the instrumental tracings) might be interpreted provisionally as phonemic mid-low.[6]

Level high was reconstructed as H for Set 1, since its surface form is stable -- unchanged -- throughout these frames. (Note that I am not saying anything, here, about stability in *other frames* -- such statements must wait for Kutsch Lojenga's more extensive paper.) *No other surface tone is stable throughout all these frames* (including the isolated form as a frame with pre and post pause); and the place of diversity, leading to setting up the reconstructed forms, differs for the various six different noun-root classes. This is the factor which first strikes one as leading to the reconstruction problem (but is precisely the face which forces one to a study of tone tunes, for explanation, as we shall see presently).

Except for final position, however, the low surface tone of Set 5 is also stable throughout -- so we ignore the mid-low prefinal glide, and reconstruct the set as L. The *only* place that the noun occurs with surface high-mid tones is in the isolation form of Row 3, Column 1; we set it up, therefore, as reconstructed H^M for that row.

This left us needing to reconstruct M, H^L, and M^L, if each of the six rows which differed from each other (i.e. combining data from 3 and 7, and 6 and 8) was to be differentiated in reconstruction, and if we were to take advantage of the fact that there were precisely six such row sets and precisely six attested surface forms (high, mid, low, and high-mid, high-low, and mid-low). How assign the other three -- with some arbitrariness if necessary -- to get a hypothetical set of reconstructions which could then be tested for fruitfulness? High-low occurred in the surface forms of the noun roots only in the isolated form (Column 1) of Row 4 and in that column of Row 6. But the remainder of the noun forms in Row 4 were either surface mid or high, whereas the remainder of the forms of the noun in Row 6 were low. So I suggested H^L for Row 4, and M^L for Row 6. (The extra height throughout the same set as Row 6, in Row 8, I treated as probably due to a raising influence from the high noun classifier preceding the root.) This left Row 2 -- the only one to which no reconstructed form had as yet been assigned -- to be reconstructed as M -- the only one of the six elements not assigned to a row, and within that row various mid tones did appear as surface forms in Columns 4 and 5 (with other columns being low).

The next problem was to make similar assignments of reconstructed forms to the elements in the frames, in Columns 1-7, which were not the noun roots themselves. I made a preliminary guess, somewhat as above. But Kutsch Lojenga pointed out that it would be preferable to have comparable assignments of reconstruction, for the final elements in the frames, to those already given to the nouns when they were final (i.e. in Column 1). We checked out the two alternatives -- and others, with Jean Reimer working through the details for us. When this had been done, we were all three convinced that the suggestion of Kutsch Lojenga stood up best, in meeting these data (and other data, which I do not give here, Kutsch Lojenga will be presenting elsewhere).[7]

B. On Toneme Complexes Versus Unit Glides

I have been talking about the data as if the glides were complexes of two level tonemes in sequence, manifested as phonetic glides. Nevertheless, there is the chance that Kutsch Lojenga may prefer to treat them as if the glides were unit phonemes, with sequential end points as features. So far as I know, this does not affect materially the basic points of interest which I am presenting in this paper. It does, however, present a deep theoretical problem in other languages[8], and must eventually be considered more seriously for this one.

C. A Crucial Observation of Stress and Nonstress as Affecting Tunes

But now we begin to search for the melodies, the tunes, which might be responsible for many of the changes observed in Figure 4. And we come to a crucial observation: On Kutsch Lojenga's instrumental recordings, the oscillograms showed an unexpected fact. In isolation, the intensity was visible in the oscillograms *only* on the final prepause syllable, *if* one first discounted those utterances, for example, where the vowels might be involved. That is, the intensity was sometimes heavier on the first syllable if it had the open vowel a but a final vowel i; but when the vowels were both a, then the intensity was heavier only on the second vowel.

We set up the hypothesis, therefore, that *stress*[9] *was the principal hidden factor guiding the general form of the morphophonemics of these phrases.*

Granted, however, the presence of stress as relevant in prepause position in Figure 4, we can see (a) that glides occur only under stress. (b) Under stress some reconstructed nonglides develop glides (Rows 2 and 5). (c) On the other hand, all reconstructed glides, when occurring nonfinal, are reduced to single level tones. (d) Reconstructed level M tone (Row 2) picks up an

added glide to low in Column 7, and a glide to high-mid in Column 6. (e) Reconstructed M^L of Row 6 drops to low, phrase medially -- but kicks up to high-low in isolation. That is, in general the melody adds or retains glides under pause-final stress, and eliminates glides, and often lowers tones, phrase medially.

D. Dome Versus Polarity or Dissimilation

We are now ready to focus specifically on the general overall contours, (or tunes, melodies) resulting from or accompanying these factors. (a) There may be many sequences of a dome[10] type, with a step up to a higher pitch followed by one down to a lower; see, for example Row 1 Column 4, low-high-low, or low-mid-low. In both of these instances the dome feature may have forced the reconstructed end to be lower.

I shall not give the list of detailed formal rules which have been developed to cover all of the instances of change in Figure 4. But two further bits must be mentioned. (a) The mid tone seems to have been largely lost because of a polarity principle; the extremes of the system swallow up some of the mid tones. (b) Almost no instances of a trough type occur. When they do, it may seem that they occur exclusively in Rows 7 and 8. There, between two high tones, a glide from high reconstructed H^M or M^L may sometimes end up as a mid toneme. The trough type of Row 7 seems, perhaps, to be a case of dissimilation[11] of a sequence of high tones or high with some glide.

FOOTNOTES

[1]For summary or description of this kind of data, see Welmers (1973), Hombert (1974), Hyman (1979), Fromkin (1978), and Clements (1979) -- or my own work (Pike and Jacobs, 1968). For downstepped tone, see Nicole (1980). This article was presented as a paper at the 15th Congress of the West African Linguistic Society in April 1982.

[2]The best discussion of such a raised toneme and level known to me, with an explicit treatment of phonological word, phonological clause, and pitch of the pause group, is that of Thomas (1974). An extensive study of up-step is found for Izi in Meier, Meier and Bendor-Samuel (1975), but with two difficulties: phonemic and morphophonemic considerations are not kept sharply enough distinct, for my taste. For example, some low tones seem to be written after they have disappeared; this is morphophonemically good, but awkward for recognizing phonemic contrasts or for recognizing the de facto development of a new tonemic level in the language. They ignore in their phonemic analysis the instances in their data when two raised tones can be seen coming together; their basis for this seems to be that the juxtaposition is across a morpheme boundary, or where a low has disappeared from between them. For examples, see RR in their text, or two vowels with dieresis (e.g. pp. 49, 68, 73).

[3]The term is used by numerous authors, e.g. Schuh (1978:230, 232, 237) and Leben (1978:181), Welmers has used the word *scope* (1973:100).

[4]The terms dissimilation and polarization are both used by Schuh (1978:241), but as 'the opposite of each other.' In dissimilation, for him, 'the affected syllable has an identifiable underlying tone' whereas in polarization 'the affected syllable has no underlying tone'. Becuwe was using the terms, however, specifying *two* opposite underlying forms for the *same* latent morpheme.

[5]Other scholars have discussed this phenomenon of a tone or tone pattern spreading over a domain of more than one syllable, but often from a somewhat different point of view. I have treated the *pattern* as unitary, and invariant, but the *syllables as each having* a toneme or *complex* of tonemes (a *toneme cluster*). The prosodic point of view -- which can handle the data well -- might be preferred within an approach which (for other or related reasons) has already been chosen with prosodies (features) extending over a substantial domain. See, for example, Leben (1978) where 'single tone feature can range over several segments' (223), with 'no regard for the number of syllables in its domain' (181), and thus 'there is no connection between tones and segments' (181); he refers to Firth's views, although he is 'not concerned with the value of prosodic analysis in general' (179); and 'the overall tone pattern' which in many languages must be mapped onto words of one, two, three, or even more syllables. See, also, Schuh (1978:223), where the generalization about a pattern mapped onto a different number of syllables 'could not be captured if tones are represented as features of vowels'; his alternative is to call for a 'suprasegmental representation of tone'. See, also, for Hausa, Hombert (1974:235). Eventually I would hope that psycholinguistic criteria would show that one or the other of the two viewpoints is psycholinguistically more useful than the other, or that *both* have psycholinguistic reality from different points of view.

Compare also Goldsmith (1976:158) who discusses different 'features of an utterance' each being eligible for treatment separately in respective '*melody levels* in the grammar' with their simultaneous occurrence something like a 'musical scoring' or 'an orchestral score image' (159). Nevertheless he says, 'Yet even if this sample were an adequate sketch of the phonetic representation, it is unquestionably the wrong picture for the more abstract -- that is, psychologically real -- level, where there are atomic units like /p/, /i/ and so forth in a word, phonemes' (158); and 'These atomic segments are what makes phonology possible' (159). Yet he feels that 'the higher level units such as phonemes and morphemes' (5) are the crucial levels for utilization in rules of generative phonology. It would appear to me rather, that further 'atomic units' are needed at higher phonological levels, such as rhythm

unit, or larger segments such as pause groups, which are also physiological chunks. See, again, Thomas (1974) or Van Dyken (1974), or Barnwell (1974:53) with 'intonation contours' (Mbembe, Cross River, Nigeria), which have a rise at the end of a 'phonological phrase' or Creissels and Kouadio with their 'courbe melodique' (1977:128) in Baoulé. Incidentally, I am indebted to Robert Carlson for making available to me a number of relevant articles while I was travelling.

[6]It seemed to me, perceptually and in the instrumental recordings, that this lowering glide sometimes started a bit higher than a preceding low toneme, and sometimes started at the level of a phonemic low; nevertheless, in the absence of a contrastive phonetic mid-low glide. I tentatively write these glides as phonemic mid-low with conditioned lowering before pause, for example. One unexplained factor may eventually force a modification in this position: Kutsch Lojenga finds that native speakers sometimes comment that that glide is very low -- lower than the low phoneme which is realized as a nonglided low both in medial and in phrase final position. If a contrastive mid-low surface form could still be found, that would quickly force the analysis to a low glide starting from the phonemic low to a further phonemic level -- not yet attested otherwise -- of a fourth (and lower) toneme than postulated in the form of presentation I have given here.

[7]She is suggesting a complementary distribution -- based on still further data not presented here -- which will relate Columns 2 and 3, and comparably 5 and 6. Thus, she will may be implying a possible deeper-level reconstruction of H^M to an older M, and of M^L to L. It will be extremely valuable if her synchronic, internal data, can then be supplemented by cross-language comparative data.

[8]But must there be here, as one of my colleagues suggested, a rule of 'one syllable, one vowel, one tone'? Under that rule of thumb, the glides would be units, not sequences of levels; they would be more like Mandarin, for example. I find the suggestion unconvincing. Would it work on, say, the vowels of English? Would they insist (as a few scholars used to do) that the vowels of boy, cow and buy were unit phonemes? Or (as the majority have done) feel that the syllable nucleus contained two phonemes (either a vowel plus another vowel, or else a vowel plus a special consonant such as w, or y)? And if they treated the syllable nucleus as necessarily a unit phoneme, would thy similarly demand that every syllable margin were also a unit phoneme -- i.e. would pl-, tr-, sp-, and str- (to mention a few among many), and -st, -nd, be unit phonemes? If not, why not? For tone discussion see Anderson (1978). Note also Bearth, for Toura, who claimed some years ago that a single syllable could have numerous moras (1968:49 -- "une seule syllable peut compter jusqu'à six mores'). More recently, for the Wobe (1980:180), he separates the moras into syllables, but treats a tone glide on a mora as being a single toneme, so that in a four-level system (plus a sub low) he has '14 tones possible on CV syllables' of which 'four are level', 'five are rising', and 'four falling and one rising-falling'.

[9]In work on Bette (Nigeria), by Peterson and Crane (in Pike 1971), the Pitch stepped down after such stressed syllables; stress was involved, then, but in a radically different way, as a kind of downdrift. Welmers (1973:113) says that 'As far as Africa is concerned no language has been reliably reported to have both tone and stress in the phonemic system'. By this, however, I am assuming that he means that no stress has been found as contrastive paradigmatically within a phonological word. Here, however, we are dealing with the constant occurrence of s stress in prepause position (or perhaps at the end of some kind of phonological word -- with details still to be worked out. Dakubu (1978:20) discusses emphasis in one language as 'generally perceived as stress' but these were when vowels differed, as for example with -a-i, and hence not applicable to our point here. See also Newman and Newman (1974) for Longuda (Adamawa-Eastern) with 'some close correlation between stress and high pitch', so that 'the first high tone syllable in a word is the stressed syllable'. Here, again, there is not a parallel to our data.

[10]Bearth called to my attention, when I was lecturing on dome and trough several months ago, that he had used the terms 'concave melodic curve' and 'convex melodic curve' for items in Wobe (Bearth and Link, 1980:169-171); or 'concavity and convexity' (181-83). In general, concave might apply to a multi-mora element where, for example, the first mora is level and the second rising; convexity would apply rather to instances such as when the first syllable is level and the second is falling.

[11]Kutsch Lojenga will presumably give us the detailed rules; I shall not do so here. Among her rules is a set which handles such dissimilation types.

We will wait with interest, not only the specific rules we may expect from Kutsch Lojenga, but more general patterns -- or a revision of these -- when she provides us with verb structures, as well as those of nouns.

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